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(54) **LIQUID CRYSTAL DISPLAY DEVICE**

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(58) **Field of Classification Search**
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USPC 349/141
See application file for complete search history.

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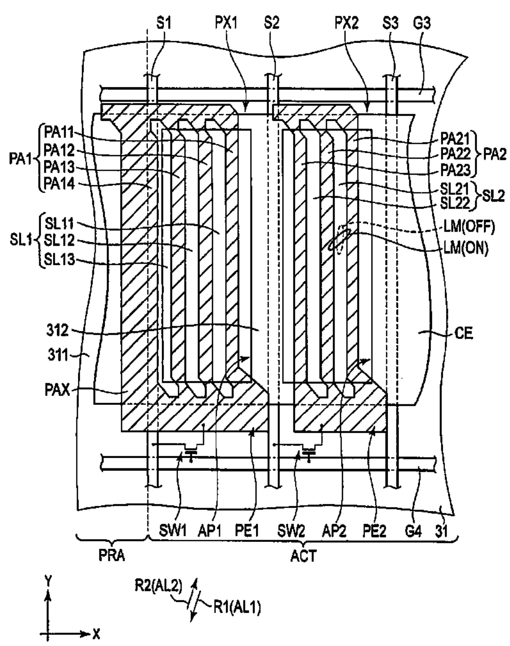
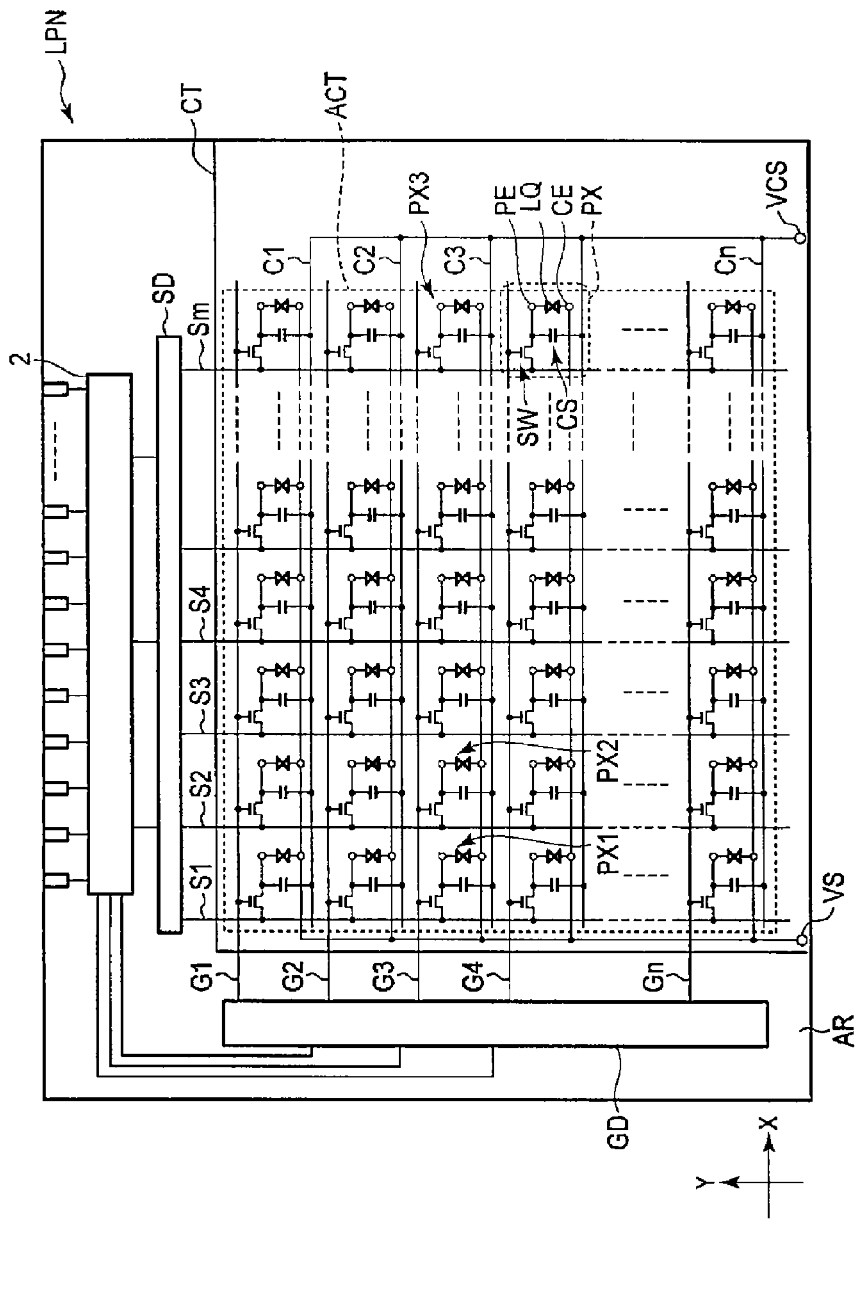
(57) **ABSTRACT**

In an array substrate, a first pixel is arranged at one end of an active area, and a second pixel is arranged adjacent to the first pixel more inside of the active area than the first pixel. A common electrode extends to the first and second pixels, and an insulating layer is formed on the common electrode. First and second pixel electrodes are formed on the insulating layer in the first and second pixels. The pixel electrodes include electrode portions forming slits facing the common electrode. A second substrate includes a shield layer arranged outside the active area. The first pixel electrode is formed more widely than the second pixel electrode, and extends to outside of the active area. The first pixel electrode includes an extending portion extending to outside of the active area and facing the shield layer.

14 Claims, 6 Drawing Sheets




LPN
2
SD
CT
ACT
PX3
PE
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CE
PX
VCS
C1
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C3
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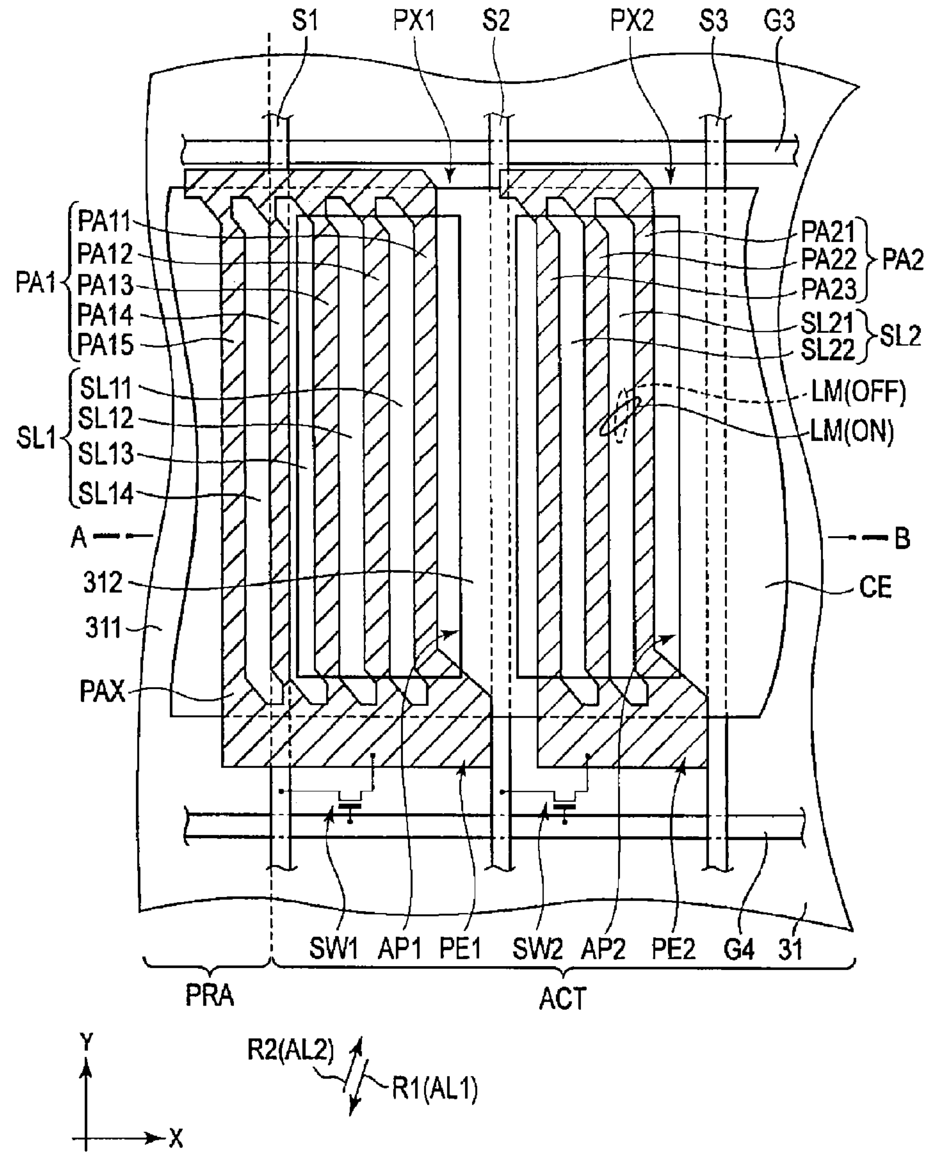
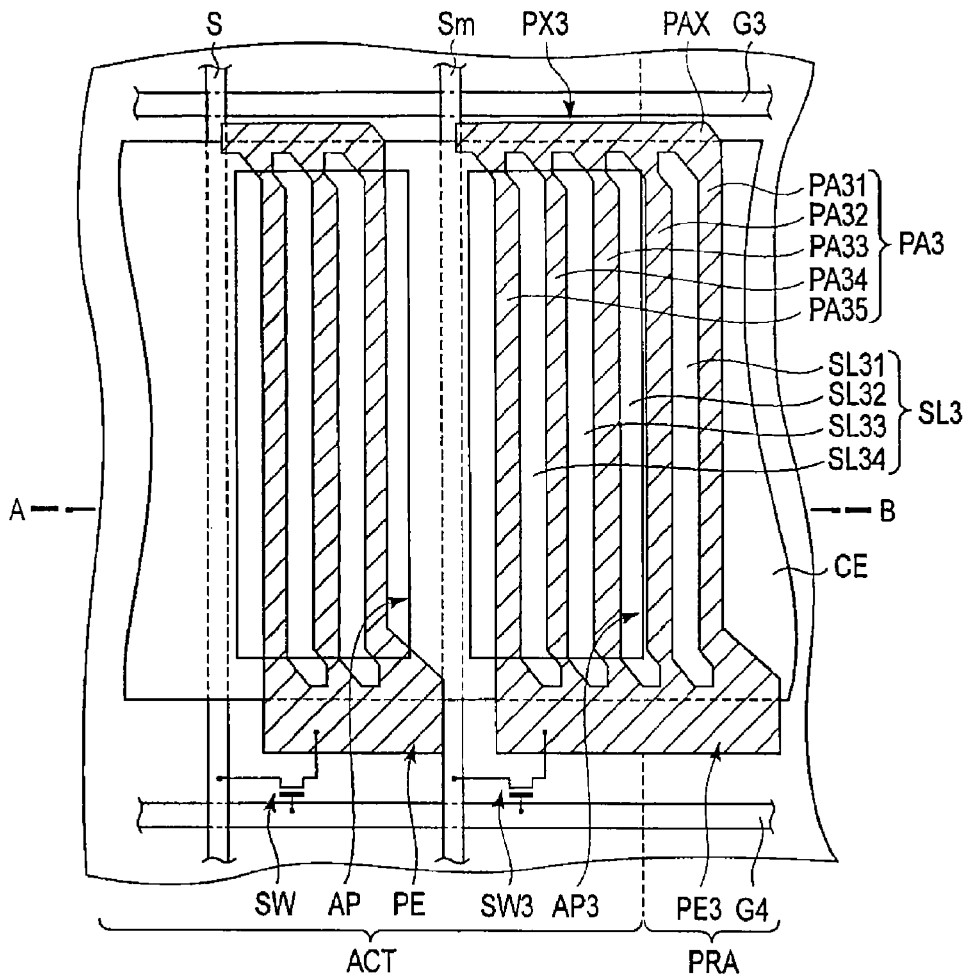
Sm
S4
S3
S2
S1
SW
CS
PX2
PX1
VS
G1
G2
G3
G4
Gn
AR
GD
X
Y

FIG.1



S1
PX1
S2
PX2
S3
G3
PA11
PA12
PA13
PA14
PA15
PA1
SL11
SL12
SL13
SL14
SL1
PA21
PA22
PA23
PA2
SL21
SL22
SL2
LM(OFF)
LM(ON)
A
B
312
311
PAX
CE
SW1
AP1
PE1
SW2
AP2
PE2
G4
31
PRA
ACT
Y
X
R2(AL2)
R1(AL1)

FIG.2



S
Sm
PX3
PAX
G3
PA31
PA32
PA33
PA34
PA35
PA3
SL31
SL32
SL33
SL34
SL3
A
B
CE
SW
AP
PE
SW3
AP3
PE3
G4
ACT
PRA

FIG.3

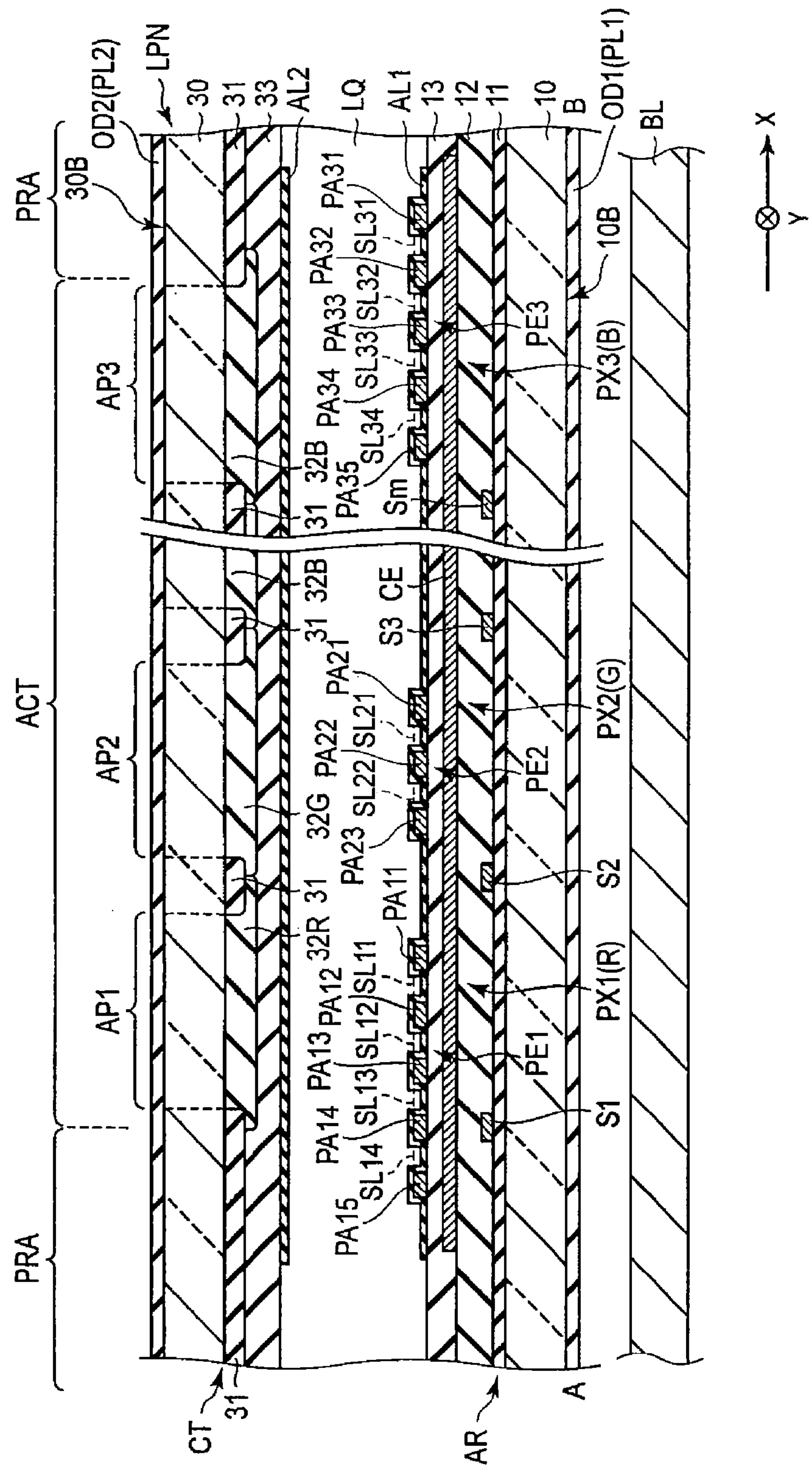
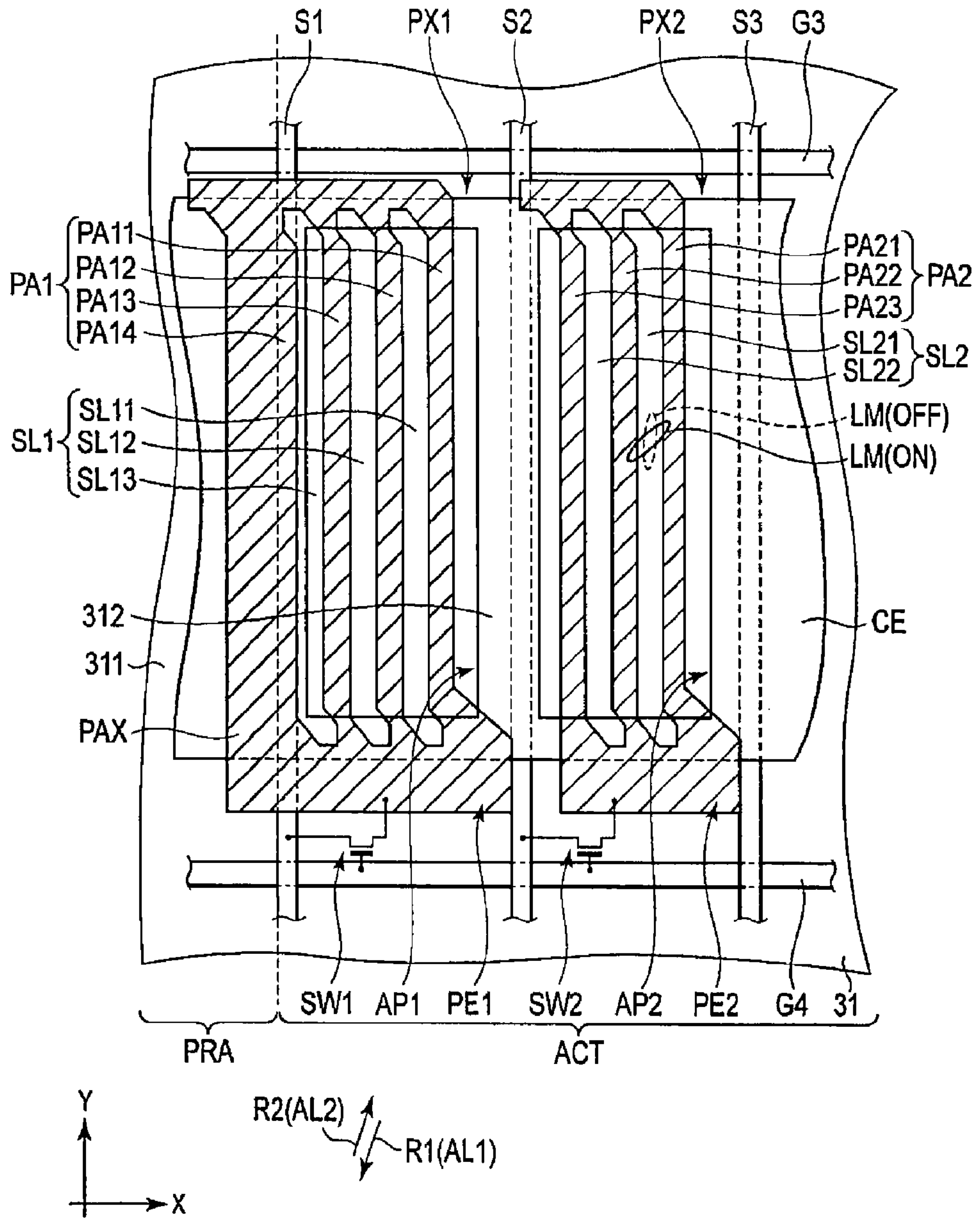

PRA
ACT
AP1
AP2
AP3
OD2(PL2)
LPN
30B
30
31
33
AL2
LQ
AL1
13
12
11
10
B
OD1(PL1)
BL
10B
32R
32G
32B
CE
S1
S2
S3
Sm
PE1
PE2
PE3
PX1(R)
PX2(G)
PX3(B)
PA11
PA12
PA13
PA14
PA15
PA21
PA22
PA23
PA31
PA32
PA33
PA34
PA35
SL11
SL12
SL13
SL14
SL21
SL22
SL31
SL32
SL33
SL34
CT
AR
A
X
Y

FIG.4



S1
PX1
S2
PX2
S3
G3
PA11
PA12
PA13
PA14
PA1
PA21
PA22
PA23
PA2
SL21
SL22
SL2
SL11
SL12
SL13
SL1
LM(OFF)
LM(ON)
312
311
CE
PAX
SW1
AP1
PE1
SW2
AP2
PE2
G4
31
PRA
ACT
Y
X
R2(AL2)
R1(AL1)

FIG.5

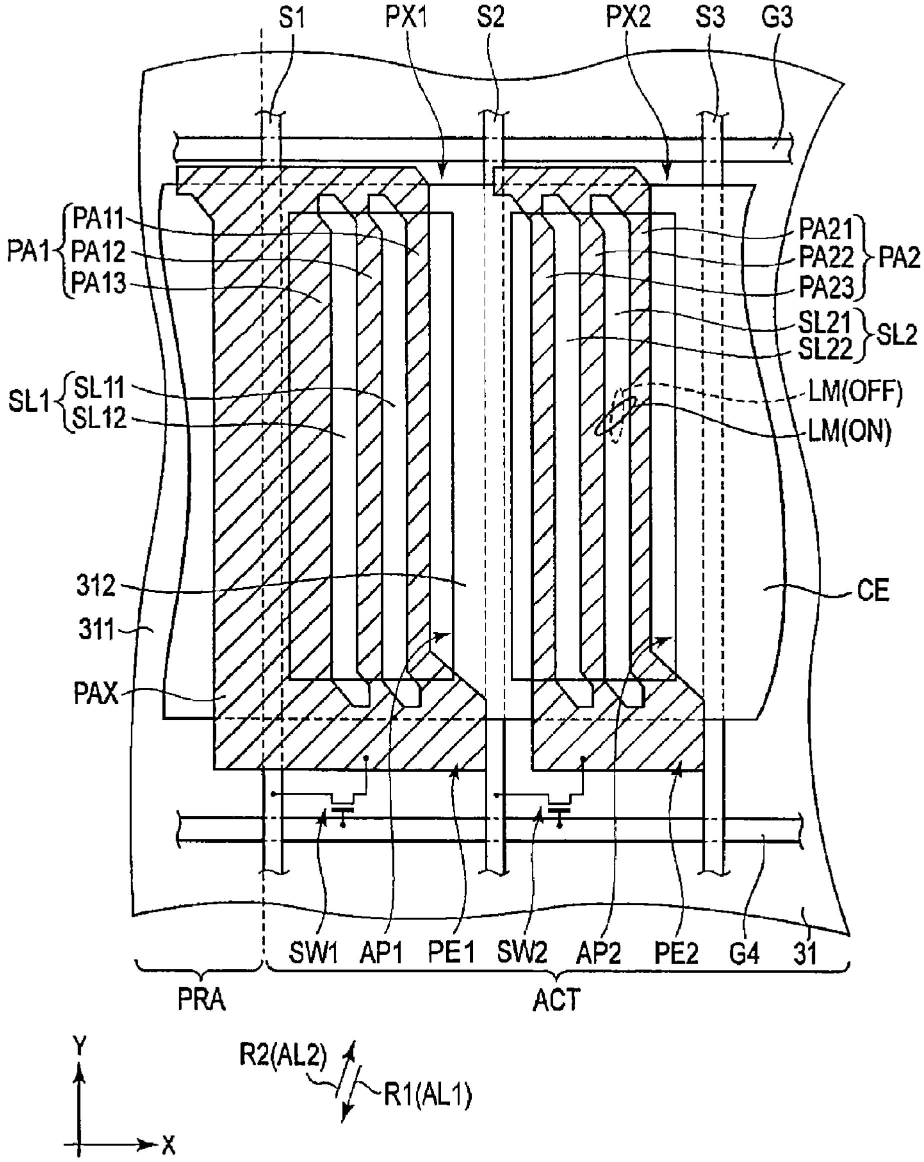

S1
PX1
S2
PX2
S3
G3
PA1
PA11
PA12
PA13
PA21
PA22
PA23
PA2
SL21
SL22
SL2
SL1
SL11
SL12
LM(OFF)
LM(ON)
312
311
CE
PAX
SW1
AP1
PE1
SW2
AP2
PE2
G4
31
PRA
ACT
Y
X
R2(AL2)
R1(AL1)

FIG.6

LIQUID CRYSTAL DISPLAY DEVICE

CROSS-REFERENCE TO RELATED APPLICATION

This application is based upon and claims the benefit of priority from prior Japanese Patent Application No. 2012-186933 filed Aug. 27, 2012, the entire contents of which are incorporated herein by reference.

FIELD

Embodiments described herein relate generally to a liquid crystal display device.

BACKGROUND

A liquid crystal display device is used in various fields of OA equipments such as a personal computer and a television set, taking advantage of the features such as light weight, thin shape, and low power consumption. In recent years, the liquid crystal display device is used also as displays for a portable remote terminal such as a cellular phone and a PDA (personal digital assistant), a car navigation equipment, and a game machine.

Generally, the liquid crystal display panel in Fringe Field Switching (FFS) mode includes an array substrate equipped with a pixel electrode and a common electrode, a counter substrate and a liquid crystal layer held therebetween. In the FFS mode, alignment of liquid crystal molecules is controlled using the fringe electric field formed between the pixel electrode and the common electrode.

Technology for arranging a dummy pixel in a non-display area covered with a shield layer is proposed as an example in the FFS mode. While the structure of the dummy pixel is substantially the same as the pixel in a display area, the dummy pixel is constituted so that electric field may not be impressed to the liquid crystal layer. The dummy pixel is used in order to form a protection device against static electricity which invades from the outside.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a portion of the specification, illustrate embodiments of the invention, and together with the general description given above and the detailed description of the embodiments given below, serve to explain the principles of the invention.

FIG. **1** is a view schematically showing a structure of a liquid crystal display device and its equivalent circuit according to one embodiment.

FIG. **2** is a plan view schematically showing structures of a first pixel and a second pixel in an array substrate shown in FIG. **1** according to a first embodiment, when seeing from a counter substrate side.

FIG. **3** is a plan view schematically showing the structure of other pixel in the array substrate shown in FIG. **1**, when seeing from a counter substrate side.

FIG. **4** is a cross-sectional view schematically showing the structure of the liquid crystal display panel including the first and second pixels taken along line A-B shown in FIGS. **2** and **3**.

FIG. **5** is a plan view schematically showing the structure of the first pixel in the array substrate shown in FIG. **1** according to a second embodiment, when seeing from the counter substrate side.

FIG. **6** is a plan view schematically showing the structure of the first pixel in the array substrate shown in FIG. **1** according to a third embodiment, when seeing from the counter substrate side.

DETAILED DESCRIPTION

A liquid crystal display device according to an exemplary embodiment of the present invention will now be described with reference to the accompanying drawings wherein the same or like reference numerals designate the same or corresponding portions throughout the several views.

According to one embodiment, a liquid crystal display device includes: a first substrate including; a first pixel arranged in one end of an active area for displaying images, and a second pixel adjacent to the first pixel in a first direction and located inside of the active area, a common electrode set to a common voltage and extending to the first and second pixels, an insulating layer formed on the common electrode, a first pixel electrode formed on the insulating layer in the first pixel, the first pixel electrode including a first electrode portion forming a first slit extending in a second direction orthogonally crossing the first direction and facing the common electrode, a second pixel electrode formed on the insulating layer in the second pixel, the second pixel electrode including a second electrode portion forming a second slit extending in the second direction and facing the common electrode, and a first alignment film covering the first and second pixel electrodes, a second substrate including; a shield layer including a first segment formed in a lattice shape extending in the first and second directions in the active area and a second segment arranged outside the active area, and a second alignment film facing the first alignment film, a liquid crystal layer held between the first alignment film and the second alignment film and having liquid crystal molecules; wherein the first pixel electrode is formed more widely than the second pixel electrode in the first direction, and extends to outside of the active area, and the first pixel electrode includes an extending portion extending to outside of the active area and facing the second segment of the shield layer.

According to other embodiment, a liquid crystal display device, includes: a first substrate including; a switching element arranged in outermost pixels located at an end of an active area for displaying images, a common electrode set to a common voltage, an insulating layer formed on the common electrode, a pixel electrode formed on the insulating layer and electrically connected with the switching element in the outermost pixels, and a first alignment film covering the pixel electrode, a second substrate including; a shield layer having a first segment extending in a first direction outside of the active area, and a second segment adjoining the first segment in a second direction orthogonally crossing the first direction and extending in the first direction in the active area so as to interpose the pixel electrode therebetween, and a second alignment film facing the first alignment film, a liquid crystal layer held between the first alignment film and the second alignment film; wherein the pixel electrode includes an electrode portion facing the common electrode and forming a slit extending in the first direction, and an end of the pixel electrode faces the first segment of the shield layer, and the other end of the pixel electrode forms a transmissive region between the other end and the second segment.

FIG. **1** is a view schematically showing a structure of a liquid crystal display device and its equivalent circuit according to one embodiment.

The liquid crystal display device includes a transmissive active-matrix type liquid crystal display panel LPN. The liquid crystal display panel LPN is equipped with an array substrate AR as a first substrate, a counter substrates CT as a second substrate arranged opposing the array substrate AR, and a liquid crystal layer LQ held between the array substrate AR and the counter substrate CT. The liquid crystal display panel LPN includes an active area ACT which displays images. For example, the active area ACT is formed in a rectangular shape. The active area ACT is constituted with a plurality of pixels PX arranged in the shape of a (m×n) matrix (here, "m" and "n" are positive integers). In this embodiment, the active area ACT includes a first pixel PX1 (outermost pixel) located at a left-hand side end of the active area ACT along a first direction X, and a second pixel PX2 adjacent to the first pixel PX1 in the first direction X, and are located more inside the active area ACT than the first pixel PX1.

The array substrate AR is equipped with "n" gate lines G (G1-Gn), "n" auxiliary capacitance lines C (C1-Cn), "m" source lines S (S1-Sm), etc., in the active area ACT. The gate line G and the auxiliary capacitance line C extend in the first direction X, respectively. The source lines S extend in a second direction orthogonally crossing the first direction X. Furthermore, the array substrate AR includes a switching element SW electrically connected with the gate line G and the source line S in each pixel PX, a pixel electrode PE electrically connected with the switching element SW in each pixel PX and a common electrode CE facing the pixel electrode PE.

The switching elements SW is formed of either a top-gate type or a bottom-gate type thin film transistor (TFT). The switching element SW includes a semiconductor layer formed of poly-silicon or amorphous silicon. The common electrode CE is formed in common to a plurality of pixels PX. Each pixel electrode PE is formed in an island shape in each pixel PX.

Each gate line G is pulled out to outside of the active area ACT, and connected to a gate driver GD. Each source line S is pulled out to the outside of the active area ACT and connected to a source driver SD. Each capacitance line C is pulled out to the outside of the active area ACT and electrically connected with a voltage impressing portion VCS to which auxiliary capacitance voltage is supplied. The common electrode CE is electrically connected with an electric supply portion VS to which common voltage is supplied. At least a portion of the gate driver GD and the source driver SD is formed in the array substrate AR, for example, and connected with the driver IC chip 2. In this embodiment, the driver IC chip 2 for driving the liquid crystal panel LPN as a signal source is mounted on the array substrate AR outside of the active area ACT in the liquid crystal panel LPN.

Moreover, the liquid crystal display panel LPN shown in the figure is constituted applicable to the FFS mode or the IPS mode, and includes the pixel electrode PE and the common electrode CE in the array substrate AR. In the liquid crystal display panel LPN, the liquid crystal molecules which constitute the liquid crystal layer LQ are switched mainly using lateral electric field (for example, electric field component of the fringe electric field substantially in parallel to a principal surface of the substrate) formed between the pixel electrode PE and the common electrode CE.

FIG. 2 is a plan view schematically showing structures of the first pixel and the second pixel electrode in the array substrate shown in FIG. 1, when seeing from the counter substrate side.

A gate line G3 and a gate line G4 extend along the first direction X, respectively. The gate line G3 and the gate line G4 are arranged with a first pitch along the second direction Y. A source line S1, a source line S2, and a source line S3 extend along the second direction Y, respectively. The source lines S1, S2, and S3 are arranged with a second pitch along the first direction X, respectively. Here, the first pitch is larger than the second pitch. The first pixel PX1 is defined by the gate line G3, the gate line G4, the source line S1, and the source line S2. The second pixel PX2 is defined by the gate line G3, the gate line G4 and the source line S2, and the source line S3. The first pixel PX1 and the second pixel PX2 have a vertical long rectangular shape whose length in the first direction X is shorter than the length in the second direction Y, for example.

The first pixel PX1 is equipped with a switching element SW1 electrically connected with the gate line G4 and the source line S1, and a pixel electrode PE1 electrically connected with the switching element SW1. The second pixel PX2 is equipped with a switching element SW2 electrically connected with the gate line G4 and the source line S2, and a pixel electrode PE2 electrically connected with the switching element SW2.

The common electrode CE set to a common voltage extends in the first direction X, and is formed in common to a plurality of pixels PX adjoining in the first direction X as shown in the figure. That is, the common electrode CE is arranged in the first pixel PX1 and the second pixel PX2 respectively striding above the source line S1, the source line S2, and the source line S3, respectively. The common electrode CE counters with the pixel electrode PE1 in the first pixel PX1, and the pixel electrode PE2 in the second pixel PX2. The pixel electrode PE1 and the pixel electrode PE2 are formed in the shape of an island corresponding to rectangular pixel form, respectively.

The pixel electrode PE1 includes a first electrode portion PA1 which forms a first slit SL1 facing the common electrode CE and extending in the second direction Y. In this embodiment, the pixel electrode PE1 includes five electrode portions PA11 to PA15 and four slits SL11 to SL14 extending along the second direction Y, respectively. That is, each of the slits SL11 to SL14 has a long axis in parallel to the second direction Y. Hereinafter, more detailed form of the pixel electrode PE1 is explained.

The slits SL11 to SL14 are arranged in a line along the first direction X. The slits SL11 to SL14 are formed so that they may have substantially the same width along the first direction X. The electrode portions PA11 to PA15 are located in a line along the first direction X. All of the electrode portions PA11 to PA15 all have substantially the same electrode width along the first direction X. The slit SL11 is formed between the electrode portion PA11 and the electrode portion PA12. The slit SL12 is formed between the electrode portion PA12 and the electrode portion PA13. The slit SL13 is formed between the electrode portion PA13 and the electrode portion PA14. The slit SL14 is formed between the electrode portion PA14 and the electrode portion PA15.

The pixel electrode PE2 includes a second electrode portion PA2 which forms the second slit SL2 facing the common electrode CE and extending in the second direction Y. In this embodiment, the pixel electrode PE2 includes three electrode portions PA21 to PA23 and two slits SL21 and SL22 extending, respectively, in the second direction Y. That is, each of the slits SL21 to SL22 has a long axis in parallel to the second direction Y. Hereinafter, more detailed form of the pixel electrode PE2 is explained.

The slits SL21 and SL22 are arranged in a line along the first direction X. The slits SL21 and SL22 are formed so that they may have substantially the same width along the first direction X. The electrode portions PA21 to PA23 are arranged in a line along the first direction X. All of the electrode portions PA21 to PA23 have substantially the same electrode width along the first direction X. The slit SL**21** is formed between the electrode portion PA**21** and the electrode portion PA**22**. The slit SL**22** is formed between the electrode portion PA**22** and the electrode portion PA**23**.

Although not illustrated, the structure of the outermost pixels (pixels PX arranged between the source line S**1** and the source line S**2**) located in the left-hand side end of the active area ACT is the same as the pixel PX**1** and equipped with a pixel electrode of the same form as the pixel electrode PE**1**. Moreover, the structure of the pixels arranged inside the outermost pixels PX in the active area ACT is the same as the structure of the pixel PX**2** and equipped with a pixel electrode of the same form as the pixel electrode PE**2**.

Each of the slits SL**11** to SL**14** in the pixel electrode PE**1** and the slits SL**21** and SL**22** in the pixel electrode PE**2** becomes a penetration region which can penetrate backlight from a backlight to be mentioned later.

The shield layer **31** to be mentioned later counters wiring portions, such as the gate line G, the source line S, and the switching element SW formed in the array substrate AR. That is, in the active area ACT, the shield layer **31** extends in the first direction X and the second direction Y, and is formed in the shape of a lattice. Moreover, the shield layer **31** is arranged also on the outside area PRA of the active area ACT. Although not explained in detail, the shield layer **31** is formed in the shape of a frame surrounding the active area ACT in the outside area PRA of the active area ACT.

In this embodiment, the shield layer **31** faces the gate line G**3**, the gate line G**4**, the source line S**1**, the source line S**2**, the source line S**3**, and the switching element SW**1**, and switching element SW**2**, and moreover extends to a region outside the first pixel PX**1** i.e., more outside than the left-hand side end of the active area. The shield layer **31** includes an approximately rectangular aperture AP**1** corresponding to the first pixel PX**1** while including an approximately rectangular aperture AP**2** corresponding to the second pixel PX**2**.

The illustrated shield layer **31** includes a segment **311** extending along the second direction Y on the outside area PRA of the active area ACT, and a segment **312** adjoining the segment **311** in the first direction X, and extending along the second direction Y in the active area ACT. The segment **312** is located between the aperture AP**1** and the aperture AP**2**.

Here, positional relationship among the pixel electrodes PE**1** and PE**2**, and the shield layer **31**.

Each second electrode portion PA**2** constituting the pixel electrode PE**2** is located inside the aperture AP**2**. That is, the electrode portion PA**21** and the electrode portion PA**23** located in the both ends of the pixel electrode PE**2** do not overlap with the shield layer **31**, but form a penetration region between the electrode portions PA**21** and PA**23** and the shield layer **31**. For example, between the electrode portion PA**23** and the segment **312**, the same penetration region as the slit SL**21**, etc., is formed.

The pixel electrode PE**1** is formed more widely than the pixel electrode PE**2** along the first direction X. That is, the pixel electrode PE**1** extends in the outside area PRA of the active area ACT and includes an extending portion PAX facing the shield layer **31**. In this embodiment, the number of the first slits SL**1** in the pixel electrode PE**1** is larger than the number of the second slits SL**2** in the pixel electrode PE**2**. That is, the number of the first electrode portions PA**1** is larger than the number of the second electrode portions PA**2**. The extending portion PAX includes a first electrode portion PA**15** and a first slit SL**14** which are respectively located in the opposite end to the pixel electrode PE**2**.

All of the electrode portions PA**11** to PA**13** are located inside the aperture AP**1** among the first electrode portions PA**1** which constitute the pixel electrode PE**1**. Moreover, all of the slits SL**11** to SL**13** among first slit SL**1** are located inside the aperture AP**1**. That is, the electrode portions PA**11** to PA**13** do not overlap with the shield layer **31**. Between the electrode portion PA**11** and the segment **312**, the same penetration region as the slit SL**11**, etc., is formed. On the other hand, the electrode portions PA**14** and PA**15** among the first electrode portion PA**1** overlap with the segment **311** of the shield layer **31**. Moreover, the slit SL**14** also overlaps with the segment **311**. Thus, one end portion (left-hand side end in the figure) of the pixel electrode PE**1** extends to the outside area PRA of the active area ACT and faces the segment **311** of the shield layer **31**. The other end portion (right-hand side end in the figure) of the pixel electrode PE**1** is constituted so that the other end portion may form a penetration region between the other end portion and the segments **312** of the shield layer **31**.

FIG. **3** is a plan view schematically showing structure of other pixel in the array substrate AR shown in FIG. **1**, when seeing from the counter substrate side.

Among the pixels PX arranged between the gate line G**3** and the gate line G**4**, a third pixel PX**3** located in the other end (right-hand end of the active area) in the first direction X in the active area ACT corresponds to the outermost pixel as well as the first pixel PX**1**. The third pixel PX**3** includes a switching element SW**3** electrically connected with the gate line G**4** and the source line Sm, and a pixel electrode PE**3** electrically connected with the switching element SW**3**.

The pixel electrode PE**3** includes a third electrode portion PA**3** which forms a third slit SL**3** facing the common electrode CE and extending in the second direction Y. In this embodiment, the pixel electrode PE**3** includes five electrode portions PA**31** to PA**35** and four slits SL**31** to SL**34** arranged in a line along the first direction X, and extending in the second direction Y, respectively.

The pixel electrode PE**3** is formed more widely than above pixel electrode PE**2** along the first direction X and has substantially the same width as the pixel electrode PE**1**. The pixel electrode PE**3** extends to the outside area PRA of the active area ACT and includes an extending portion PAX extending in the outside area PRA of the active area ACT facing the shield layer **31** as well as the first pixel electrode PE**1**. Although not explained in detail, the extending portion PAX includes a third electrode portion (PA**31** and PA**32**) and the third slit (SL**31**).

All the electrode portions PA**33** to PA**35** are located inside the aperture AP among the third electrode portion PA**3** shown in the figure. Moreover, all of the slits SL**32** to SL**34** among the third slits SL**3** are located inside the aperture AP. That is, the electrode portions PA**33** to PA**35** do not overlap with the shield layer **31**. Thus, also in the third pixel electrode PE**3**, one end portion (right-hand end in the figure) of the pixel electrode PE**3** extends to the outside area PRA of the active area ACT and faces the shield layer **31** as well as the first pixel electrode PE**1**. The other end portion (left-hand end in the figure) of the pixel electrode PE**3** is constituted so that the other end portion may form a penetration region between the other end portion and the shield **31**.

FIG. **4** is a cross-sectional view schematically showing the structure of the liquid crystal display panel including the first and second pixels taken along line A-B shown in FIGS. **2** and **3**.

The array substrate AR is formed using a first insulating substrate **10** which has light transmissive characteristics, such as a glass substrate and a resin substrate. The array substrate AR includes switching element which is not illustrated, source lines S**1** to S**3**, Sm, a common electrode CE, pixel electrodes PE**1** to PE**3**, a first insulating film **11**, a second insulating film **12**, a third insulating film **13**, and a first alignment film ALL etc., respectively, formed on the first substrate **10** facing the counter substrate CT.

The first insulating film **11** is arranged on the first insulating substrate **10**. The source lines S**1** to S**3**, Sm, etc., are formed on the first insulating film **11** and covered with the second insulating film **12**. The second insulating film **12** is arranged also on the first insulating film **11**.

The common electrode CE is formed on the second insulating film **12**. The common electrode CE is formed by transparent electric conductive material, for example, Indium Tin Oxide (ITO), Indium Zinc Oxide (IZO), etc. The common electrode CE is covered with the third insulating film **13**. The third insulating film **13** is also arranged on the second insulating film **12**.

The pixel electrodes PE**1** to PE**3** are formed on the third insulating film **13**, respectively, and face the common electrode CE. The pixel electrodes PE**1** to PE**3** are formed by transparent electric conductive material, for example, ITO, IZO, etc. The pixel electrodes PE**1** to PE**3** are covered with the first alignment film AL**1**. The first alignment film AL**1** also covers the third insulating film **13**. The first alignment film AL**1** is formed of the material which shows horizontal alignment characteristics.

On the other hand, the counter substrate CT is formed using a second insulating substrate **30** such as a glass substrate and a resin substrate, etc., which has transmissive characteristics. The counter substrate CT includes the shield layer **31**, a color filter **32**, an overcoat layer **33**, and the second alignment film AL**2**, etc., on the second insulating substrate **30** facing the array substrate AR.

The shield layer **31** defines each pixel PX in the active area ACT, and forms the apertures AP**1** to AP**3**. The shield layer **31** is arranged so that the shield layer **31** counters wiring portions, such as the gate line and the switching element which are not illustrated, the source lines S**1** to S**3**, Sm. Moreover, the shield layer **31** also extends to outside area PRA of the active area ACT.

The color filter **32** is arranged corresponding to each pixel PX. That is, the color filter **32** is arranged in the apertures AP**1** to AP**3**, and a portion thereof runs on the shielding layer **31**. The colors of the color filter **32** arranged in adjoining pixels PX in the first direction X differ mutually. For example, the color filter **32** is formed of resin materials colored by three primary colors of red, blue, and green, respectively. The red color filter formed of resin material colored in red is arranged corresponding to the red pixel. The blue color filter formed of resin material colored in blue is arranged corresponding to the blue pixel. The green color filter formed of resin material colored in green is arranged corresponding to the green pixel. In this embodiment, the first pixel PX**1** corresponds to the red pixel (R), and a red color filter **32**R is arranged in the aperture AP**1**. The second pixel PX**2** corresponds to the green pixel (G), and a green color filter **32**G is arranged in the aperture AP**2**. The third pixel PX**3** corresponds to the blue pixel (B), and the blue color filter **32**B is arranged in the aperture AP**33**. The boundary between the adjoining color filters **32** is located in a position which overlaps with the shield layer **31**.

The overcoat layer **33** covers the color filter **32**. The overcoat layer **32** eases influence of concave-convex of the surface of the shield layer **31** and the color filter **32**. That is, the surface of the overcoat layer **33** facing the array substrate AR is substantially flat. The overcoat layer **33** is formed of a transparent resin material. The surface of the overcoat layer **33** is covered with the second alignment film AL**2**. The second alignment film AL**2** is formed of material which shows horizontal alignment characteristics.

In the pixel electrode PE**1**, the slits SL**11** to SL**13** and the electrode portions PA**11** to PA**13** face the aperture AP**1** and the red color filter **32**R. Moreover, in the pixel electrode PE**1**, the slit SL**14**, and the electrode portions PA**14** and PA**15** face the shield layer **31**, respectively. In the pixel electrode PE**3**, the slits SL**32** to SL**34** and electrode portions PA**33** to PA**35** face the aperture AP**3** and the blue color filter **32**B. Moreover, the slit SL**31**, and the electrode portions PA**31** and PA**32** face the shield layer **31**. In addition, the pixel electrode PE**2** faces the aperture AP**2** and the green color filter **32**G. The pixel electrode PE**3** faces the aperture AP**3** and the blue color filter **32**B.

The array substrate AR and the counter substrate CT as mentioned above are arranged so that the first alignment film AL**1** and the second alignment film AL**2** face each other. At this time, a predetermined cell gap is formed by a pillar-shaped spacer formed in one of the substrates between array substrate AR and the counter substrate CT. The array substrate AR and the counter substrate CT are pasted together by a seal material while the cell gap is formed. The liquid crystal layer LQ is constituted by liquid crystal composite containing liquid crystal molecules LM enclosed in the cell gap formed between the first alignment film AL**1** of the array substrate AR and the second alignment film AL**2** of the counter substrate CT. The liquid crystal layer LQ is formed of liquid crystal materials with positive dielectric constant anisotropy, for example.

A backlight **4** is arranged on the back side of the array substrate AR. Various types of backlights can be used. For example, a light emitting diode (LED) and a cold cathode fluorescent lamp (CCFL), etc., can be applied as a light source of the backlight **4**, and the explanation about its detailed structure is omitted.

A first optical element OD**1** having a first polarization plate PL**1** is arranged on an external surface of the array substrate AR, i.e., an external surface **10**B of the first insulating substrate **10**. Moreover, a second optical element OD**2** having a second polarization plate PL**2** is arranged on an external surface of the counter substrate CT, i.e., an external surface **30**B of the second insulating substrate **30**. The first polarization axis of the first polarization plate PL**1** and the second polarizing axis of the second polarization plate PL**2** are arranged in Cross Nicole's positional relationship, for example.

As shown in FIG. **2**, alignment treatment, for example, rubbing treatment or light alignment treatment, is carried out to the first alignment film AL**1** and the second alignment film AL**2** in a parallel direction each other, in a face in parallel to a substrate principal surface (or X-Y plane). The alignment treatment of the first alignment film AL**1** is carried out in a direction intersecting with an acute angle of 45° or less to the second direction Y. The alignment treatment direction R**1** of the first alignment film AL**1** and the alignment treatment direction R**2** of the second alignment film AL**2** are directions which cross the second direction Y with angle of 5°-15° to the second direction Y, for example. In addition, the alignment treatment direction R**1** and the alignment treatment direction R**2** are opposite directions mutually.

In addition, the first polarizing axis of the first polarization plate PL**1** is set to a substantially parallel direction to the alignment treatment direction R**1** of the first alignment film AL**1**, and the second polarizing axis of the second polarization plate PL**2** is set to a direction orthogonally crossing the alignment treatment direction R**1** of the first alignment film AL.

Hereinafter, an operation example (normally black) in the liquid crystal display device according to this embodiment is explained.

At the time of OFF when a voltage forming potential difference between the pixel electrode PE and the common electrode CE is not impressed, the voltage is not impressed to the liquid crystal layer LQ, and electric field is not formed between the pixel electrode PE and the common electrode CE. For this reason, as shown with a dotted line in FIG. **2**, the liquid crystal molecules LM contained in the liquid crystal layer LQ initially align in the alignment treatment directions of the first alignment film AL**1**, and the second alignment film AL**2** in the X-Y plane. The alignment direction to which the liquid crystal molecules LM initially align is called an initial alignment direction. At the time of OFF, a portion of the backlight from the backlight BL penetrates the first polarization plate PL**1**, and enters into the liquid crystal display panel LPN. The backlight which entered into the liquid crystal display panel LPN is linearly polarized light which intersects perpendicularly with the first polarizing axis of the first polarization plate PL**1**. When the polarization state of the linearly polarized light passes the liquid crystal display panel LPN at the time of OFF, the polarization state hardly changes. For this reason, the linearly polarized light penetrating the liquid crystal display panel LPN is absorbed by the second polarization plate PL**2** arranged in Gross Nicole's positional relationship with respect to the first polarization plate PL**1** (black display).

On the other hand, when a voltage forming potential difference between the pixel electrode PE and the common electrode CE is impressed, the voltage is impressed to the liquid crystal layer LQ, and the fringe electric field is formed between the pixel electrode PE and the common electrode CE. For this reason, as shown with a solid line in FIG. **2**, the liquid crystal molecules LM contained in the liquid crystal layer LQ aligns in a different direction from the initial alignment direction in the X-Y plane. In the positive type liquid crystal material, the liquid crystal molecules LM align so that the long axis of the liquid crystal molecules LM aligns in parallel to the electric field. In this ON time, the linearly polarized light orthogonally crossing the first polarizing axis of the first polarization plate PL**1** enters in the display panel LPN. The polarization state of the linearly polarized light changes in accordance with the alignment state (or retardation) of the liquid crystal molecule LM when passing the liquid crystal layer LQ. Therefore, at the ON time, at least a portion of the backlight which passes the liquid crystal layer LQ penetrates the second polarization plate PL**2** (white display).

By the way, in the FFS mode which controls the liquid crystal molecule LM using the fringe electric field, when the third insulating film **13** located between the common electrode CE and the pixel electrode PE is charged in a manufacture process, etc., electric charges may be localized in the outermost circumference in the active area, and may give a bad influence on the display. Accordingly, a display defect may be generated PX in the pixels including the first pixel PX**1** arranged in the second direction Y in an outermost circumference of the left-hand side end or the pixels including the third pixel PX**3** arranged in the second direction Y in an outermost circumference of the right-hand side en,. That is, even at the OFF state in which electric field is not formed between the pixel electrode PE and the common electrode CE, the alignment of the liquid crystal molecule LM is disordered due to the influence by the localized electric charges. Especially, in case of normally black, the backlight leaks even in a black display. Accordingly, the backlight leak causes deterioration of display grace.

In this embodiment, in the first pixel PX**1**, the pixel electrode PE**1** is widened in the first direction X so that the pixel electrode PE**1** faces the aperture AP**1** and the shield layer **31** in the outside area PRA of the active area ACT. Similarly, in the third pixel PX**3**, the pixel electrode PE**3** is widened in the first direction X so that the pixel electrode PE**3** faces the aperture AP**3** and the shield layer **31** of the outside area PRA of the active area ACT. Thereby, the region which locally holds the undesirable electric charges between the pixel electrode PE**1** and the common electrode CE or between the pixel electrode PE**3** and the common electrode CE is located in the outside area PRA of the active area ACT. For this reason, even if the third insulating film **13** is charged and the electric charges are localized, since the region in which the alignment of the liquid crystal molecule LM is disordered is shielded by the shield layer **31**, it becomes possible to control the optical leak in the active area ACT and also to control the deterioration of display grace.

Next, a second embodiment is explained. In addition, the same referential mark is attached to the same elements as the above structure, and detailed explanation is omitted. FIG. **5** is a plan view schematically showing other structure of the first pixel PX**1** in the array substrate AR shown in FIG. **1**, when seeing from the counter substrate side.

This embodiment is different from the first embodiment shown in FIG. **2** in that the electrode portion PA**14** of the pixel electrode PE**1** is widened to form the extending portion PAX. In addition, the structure of the pixel electrode PE**2** is the same as that of the above-mentioned first embodiment.

In this embodiment, the pixel electrode PE**1** includes four electrode portions PA**11** to PA**14** arranged in the first direction X so as to extend in the second direction Y, respectively, and three slits SL**11** to SL**13** arranged in the first direction X and extending in the second direction Y, respectively. All of the electrode portions PA**11** to PA**13** have substantially the same width in the first direction X. The width of the electrode portion PA**14** in the first direction X is wider than the width of the electrode portion PA**13**, et al., in the first direction X. The slit SL**11** is formed between the electrode portion PA**11** and the electrode portion PA**12**. The slit SL**12** is formed between the electrode portion PA**12** and the electrode portion PA**13**. The slit SL**13** is formed between the electrode portion PA**13** and the electrode portion PA**14**.

The pixel electrode PE**1** is wider than the pixel electrode PE**2** along the first direction X and includes an extending portion PAX extending to the outside area PRA of the active area ACT. In this embodiment, the number of the first slits SL**1** in the pixel electrode PE**1** is larger than the number of the second slits SL**2** in the pixel electrode PE**2**. That is, the number of the first electrode portions PA**1** is larger than the number of the second electrode portions PA**2**.

Here, if its attention is paid to the positional relationship between the pixel electrode PE**1** and the shield layer **31**, the three electrode portions PA**11** to PA**13** in the first electrode portion PA**1** which constitutes the pixel electrode PE**1** are located inside of the aperture AP**1**. Furthermore, all the slits SL**11** to SL**13** are located inside of the aperture AP**1**. That is, the electrode portions PA**11** to PA**13** do not overlap with the shield layer **31**. On the other hand, the electrode portion PA**14** overlaps with the segment **311** of the shield layer **31** among the first electrode portions PA**1**. That is, the extending portion PAX corresponds to the electrode portion PA**14** located at the opposite end to, the pixel electrode PE**2**. In addition, the illustrated extending portion PAX includes neither of the slits.

Also in the second embodiment, the same effect is acquired as the first embodiment.

FIG. **6** is a plan view schematically showing other structure of the first pixel in the array substrate shown in FIG. **1** according to a third embodiment, when seeing from the counter substrate side.

The structure according to this embodiment is different from the structure shown in FIG. **5** in the point that the extending portion PAX is formed by widening the electrode portion PA**13** of the pixel electrode PE**1**. In addition, the structure of the pixel electrode PE**2** is the same as that of the above-mentioned structure.

In this embodiment, the pixel electrode PE**1** includes three electrode portions PA**11** to PA**13** arranged in the first direction X and extending in the second direction Y, respectively, and two slits SL**11** and SL**12** arranged in the first direction X and extending in the second direction Y, respectively. The electrode portions PA**11** and PA**12** have substantially the same width in the first direction X. The width of the electrode portion PA**13** in the first direction X is wider than the width of the electrode portion PA**12**, et al., in the first direction X. The slit SL**11** is formed between the electrode portion PA**11** and the electrode portion PA**12**. The slit SL**12** is formed between the electrode portion PA**12** and the electrode portion PA**13**.

The pixel electrode PE**1** is formed more widely than the pixel electrode PE**2** along the first direction X and includes an extending portion PAX extending to the outside area PRA of the active area ACT. In this embodiment, the number of the first slit SL**1** in the pixel electrode PE**1** is the same as the number of the second slit SL**2** in the pixel electrode PE**2**. That is, the number of the first electrode portions PA**1** is the same as the number of the second electrode portions PA**2**.

Here, if its attention is paid to the positional relationship between the pixel electrode PE**1** and the shield layer **31**, the two electrode portions PA**11** and PA**12** in the first electrode portion PA**1** which constitutes the pixel electrode PE**1** are located inside of the aperture AP**1**. Furthermore, the slits SL**11** and SL**12** are located inside of the aperture AP**1**. That is, the electrode portion PA**13** extends from a location facing the aperture AP**1** to the outside area PRA of the active area ACT. While, a portion of the electrode portion PA**13** is located inside of the aperture AP**1**, the other portion overlaps with the segment **311** of the shield layer **31**. That is, the extending portion PAX corresponds to the electrode portion PA**13** located in the opposite end to the pixel electrode PE**2**. In this embodiment, the illustrated extending portion PAX includes neither of the slits.

Also in the above structure, the same effect as the first embodiment is acquired.

As explained above, according to the embodiments, the liquid crystal display device which can control deterioration of display grace can be supplied.

In the above embodiment, while the slit SL of the pixel electrode PE is formed so that the slit SL have a long axis in parallel to the second direction Y, the slit SL may be formed so that the slit SL may have a long axis in parallel to the first direction X, Furthermore, the pixel electrode PE may be formed so that the slit SL have a long axis in a direction crossing the first direction X and second direction Y or is crooked at a sharp angle.

While certain embodiments have been described, these embodiments have been presented by way of embodiment only, and are not intended to limit the scope of the inventions. In practice, the structural elements can be modified without departing from the spirit of the invention. Various embodiments can be made by properly combining the structural elements disclosed in the embodiments. For embodiment, some structural elements may be omitted from all the structural elements disclosed in the embodiments. Furthermore, the structural elements in different embodiments may properly be combined. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall with the scope and spirit of the inventions.

What is claimed is:

1. A liquid crystal display device, comprising:

a first substrate including;

a first pixel arranged in one end of an active area for displaying images, and a second pixel adjacent to the first pixel in a first direction and located inside of the active area,

a common electrode set to a common voltage and extending to the first and second pixels,

an insulating layer formed on the common electrode,

a first pixel electrode formed on the insulating layer in the first pixel, the first pixel electrode including a first electrode portion forming a first slit extending in a second direction orthogonally crossing the first direction and facing the common electrode,

a second pixel electrode formed on the insulating layer in the second pixel, the second pixel electrode including a second electrode portion forming a second slit extending in the second direction and facing the common electrode, and

a first alignment film covering the first and second pixel electrodes,

a second substrate including;

a shield layer including a first segment formed in a lattice shape extending in the first and second directions in the active area and a second segment arranged outside the active area, and

a second alignment film facing the first alignment film,

a liquid crystal layer held between the first alignment film and the second alignment film and having liquid crystal molecules; wherein

the first pixel electrode is formed more widely than the second pixel electrode in the first direction, and extends to outside of the active area, and

the first pixel electrode includes an extending portion extending to outside of the active area and facing the second segment of the shield layer.

2. The liquid crystal display device according to claim **1**, wherein the extending portion includes the first electrode portion arranged at an opposite end to the second pixel electrode.

3. The liquid crystal display device according to claim **2**, wherein the extending portion includes the first slit.

4. The liquid crystal display device according to claim **1**, wherein the number of the first slit is larger than the number of the second slit.

5. The liquid crystal display device according to claim **1**, wherein the number of the first slit is the same as the number of the second slit,

the second segment of the shield layer faces the extending portion and extends in the second direction, and

the first slit is not arranged in the extending portion.

6. The liquid crystal display device according to claim **1**, wherein

the shield layer includes a third segment extending in the second direction and located between the first pixel electrode and the second pixel electrode in the active area, and

respective transmissive regions are formed between the third segment of the shield layer and the first electrode portion, and between the third segment of the shield layer and the second electrode portion.

7. The liquid crystal display device according to claim **1**, wherein

the second substrate includes a first color filter colored in a first color extending in the second direction in the first pixel, and a second color filter colored in a second color extending in the second direction in the second pixel.

8. The liquid crystal display device according to claim **1**, wherein the liquid crystal molecules are driven by a Fringe Field Switching (FFS) mode.

9. A liquid crystal display device including a plurality of pixels, comprising:

a first substrate including;

gate lines extending in a first direction,

source lines extending in a second direction orthogonally crossing

the first direction,

a first pixel arranged in an outermost circumference of an active area displaying images, and a second pixel arranged adjoining the first pixel in a first direction so as to locate more inside of the active area than the first pixel, the first and second pixels defined by the adjoining gate lines and the source lines,

a common electrode set to a common voltage extending to the first and second pixels,

an insulating layer formed on the common electrode, a first pixel electrode formed on the insulating layer in the first pixel, the first pixel electrode including a first electrode portion forming a first slit extending in a second direction orthogonally crossing the first direction and facing the common electrode, a second pixel electrode formed on the insulating layer in the second pixel, the second pixel electrode including a second electrode portion forming a second slit extending in the second direction and facing the common electrode, and a first alignment film covering the first and second pixel electrodes, a second substrate including;

a shield layer including a first segment formed in a lattice shape extending in the first and second directions in the active area and a second segment arranged outside the active area, and

a second alignment film facing the first alignment film,

a liquid crystal layer held between the first alignment film and the second alignment film and having liquid crystal molecules; wherein

the first pixel electrode is formed more widely than the second pixel electrode in the first direction, and extends to outside of the active area,

the first pixel electrode includes an extending portion extending to outside of the active area and facing the second segment of the shield layer, and

the first electrode portion is arranged in the extending portion facing the shield layer.

10. The liquid crystal display device according to claim **9**, wherein the first electrode portion arranged in the extending portion of the first pixel electrode includes the first slit.

11. The liquid crystal display device according to claim **9**, wherein the number of the first slit is larger than the number of the second slit.

12. The liquid crystal display device according to claim **9**, wherein

the shield layer includes a third segment extending in the second direction and located between the first pixel electrode and the second pixel electrode, and

respective transmissive regions are formed between the third segment of the shield layer and the first electrode portion, and between the third segment of the shield layer and the second electrode portion.

13. The liquid crystal display device according to claim **9**, wherein

the liquid crystal molecules are driven by a Fringe Field Switching (FFS) mode.

14. The liquid crystal display device according to claim **9**, wherein

the second substrate includes a first color filter colored in a first color extending in the second direction in the first pixel, and a second color filter colored in a second color extending in the second direction in the second pixel.

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